Oxoboxo Brook

Watershed Summary

Watershed Description and Maps

The Oxoboxo Brook watershed covers an area of approximately 6,518 acres in southeastern Connecticut (Figure 1). The watershed is located primarily in Montville, CT, with northern portions extending into Salem, CT.

The Oxoboxo Brook watershed includes one segment impaired for recreation due to elevated bacteria levels. This segment was assessed by Connecticut Department of Energy and Environmental Protection (CT DEEP) and included in the CT 2010 303(d) list of impaired waterbodies. The other segment (CT3004-00_02) in the watershed is currently unassessed as of the writing of this document. This does not mean there are no potential issues on this segment, but indicates a lack of current data to evaluate the segment as part of the assessment process. An excerpt of the Integrated Water Quality Report is included in Table 1 to show the status of other waterbodies in the watershed (CTDEEP, 2010).

Oxoboxo Brook begins at the dam outlet to Oxoboxo Lake in Montville, CT, flows southerly parallel to Old Colchester Road, crosses Oxoboxo Dam Road and Williams Road, continues through Paris Pond, Scholfield Pond, and Oakdale Pond, bisects Meeting House Lane, enters Wheeler Pond, flows between Route 163 and Maple Avenue through Rockland Pond and Red Mill Pond, crosses Route 395, flows through a second Red Mill Pond, crosses Norwich-New London Turnpike (Route 32), and ends at the inlet to Horton Cove along the Thames River in Montville, CT. The bacteria impaired segment (CT3004-00_01) consists of 2.62 miles of the river in Montville, CT (Figure 2). This impaired segment begins at the dam outlet to Wheeler Pond in Montville, CT, flows between Route 163 and Maple Avenue through Rockland Pond and Red Mill Pond, crosses Route 395 and Route 32, and ends at the inlet to Gay Cemetery Pond in Horton Cove along the Thames River in Montville, CT.

Impaired Segment Facts

Impaired Segment: Oxoboxo Brook (CT3004-00_01)

Municipalities: Montville

Impaired Segment Length (miles): 2.62

Water Quality Classification: Class B

Designated Use Impairment: Recreation

Sub-regional Basin Name and Code: Oxoboxo Brook, 3004

Regional Basin: Thames Main Stem

Major Basin: Thames

Watershed Area (acres): 6,518

MS4 Applicable? Yes

Applicable Season: Recreation Season (May 1 to September 30)

Figure 1: Watershed location in Connecticut

The impaired segment of Oxoboxo Brook has a water quality classification of B. Designated uses include habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. As there are no designated beaches in this segment of the Oxoboxo Brook, the specific recreation impairment is for non-designated swimming and other water contact related activities.

Table 1: Impaired segment and nearby waterbodies from the Connecticut 2010 Integrated Water Quality Report

Waterbody ID	Waterbody Name	Location	Miles	Aquatic Life	Recreation	Fish Consumption
CT3004-00_01	Oxoboxo Brook-01	From mouth at head of tide (inlet to Gay Cemetery Pond, Horton Cove, Thames River), US to Wheeler Pond outlet dam, Montville. (Segment includes Rockland Pond)	2.62	U	NOT	FULL
CT3004-00_02	Oxoboxo Brook-02	From inlet to Wheeler Pond (northwestern portion, DS of Meeting House Lane road crossing), US to Oxoboxo Lake outlet dam. (Includes Scholfield Pond)	2.95	U	U	FULL

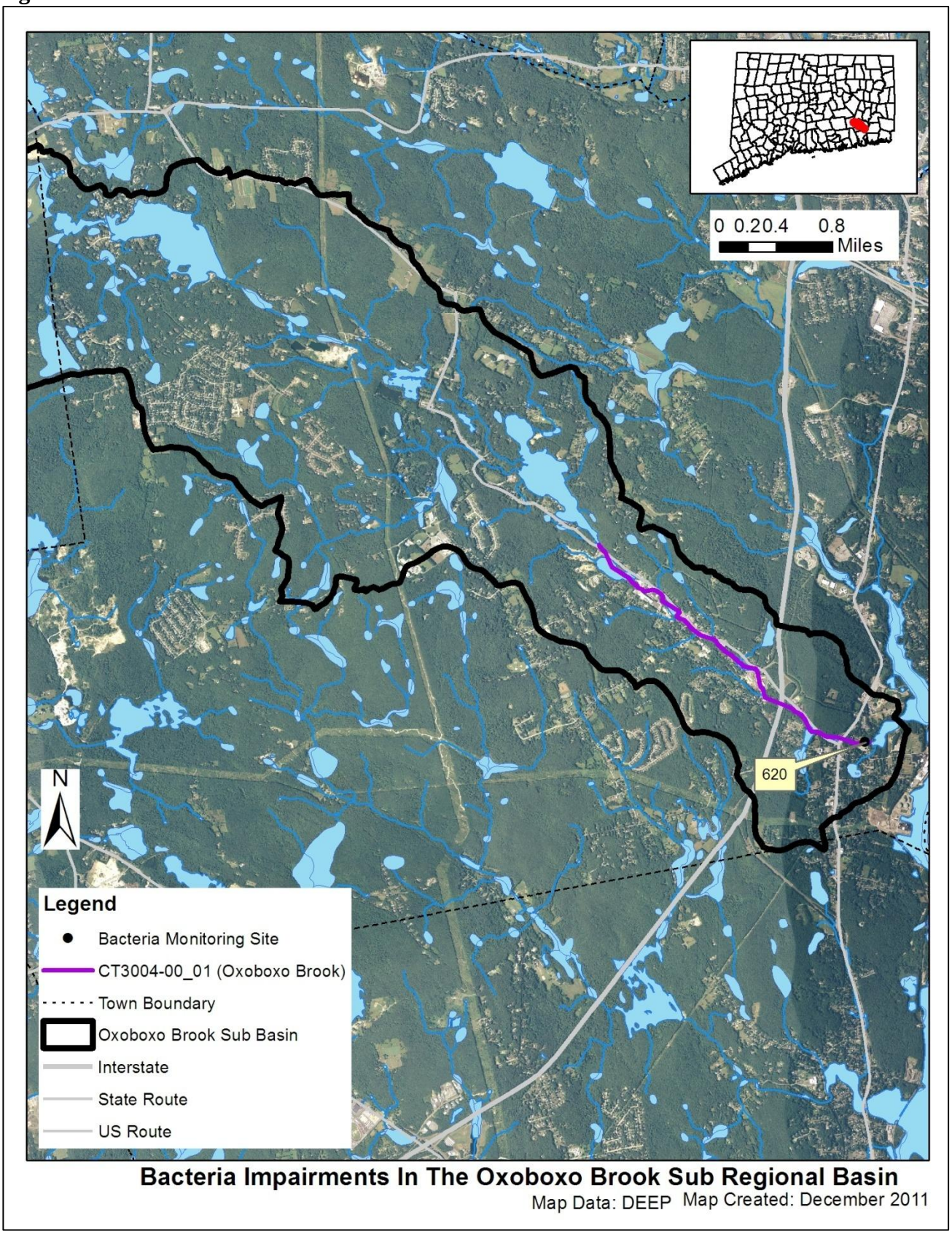
Shaded cells indicate impaired segment addressed in this TMDL

FULL = Designated Use Fully Supported

NOT = Designated Use Not Supported

U = Unassessed

Figure 2: GIS map featuring general information of the Oxoboxo Brook watershed at the sub-regional level



Land Use

Existing land use can affect the water quality of waterbodies within a watershed (USEPA, 2011c). Natural processes, such as soil infiltration of stormwater and plant uptake of water and nutrients, can occur in undeveloped portions of the watershed. As impervious surfaces (such as rooftops, roads, and sidewalks) increase within the watershed landscape from commercial, residential, and industrial development, the amount of stormwater runoff to waterbodies also increases. These waterbodies are negatively affected as increased pollutants from nutrients and bacteria from failing and insufficient septic systems, oil and grease from automobiles, and sediment from construction activities become entrained in this runoff. Agricultural land use activities, such as fertilizer application and manure from livestock, can also increase pollutants in nearby waterbodies (USEPA, 2011c).

As shown in Figures 3 and 4, the Oxoboxo Brook watershed consists of 58% forest, 26% urban, 10% water, and 6% agricultural land uses. Upstream of the impairment are large tracts of forested land with hayfields, row crops, and livestock farms along Route 163 on the outskirts of the watershed. Several residential areas and developed open spaces, including the Quaker Hill Rod & Gun Club, are located immediately adjacent to Oxoboxo Brook. A large sand pit and dumpsite with an identified septage lagoon near Paris Pond and a motel and community area with tennis and basketball courts at the Route 163 crossing are located adjacent to Oxoboxo Brook as well. Wheeler Pond is heavily developed with residential homes located adjacent to or near the shoreline. Several pockets of disturbed areas with exposed soil can be found on the east and west side of Wheeler Pond. Also identified was a livestock or horse pasture to the north, a large home with lawn extending right to the shoreline to the southeast, and an industrial area with exposed soil to the west. The impaired segment of Oxoboxo Brook continues through industrial and commercial development areas, which include car lots, Advanced Self Storage, the American Legion, Montville Animal Control, Connecticut Scrap lot downstream of Picker Pond, Natchaug Hospital Joshua Center, St. Patrick Cemetery, and Montville Wastewater Treatment Plant.

Figure 3: Land use within the Oxoboxo Brook watershed

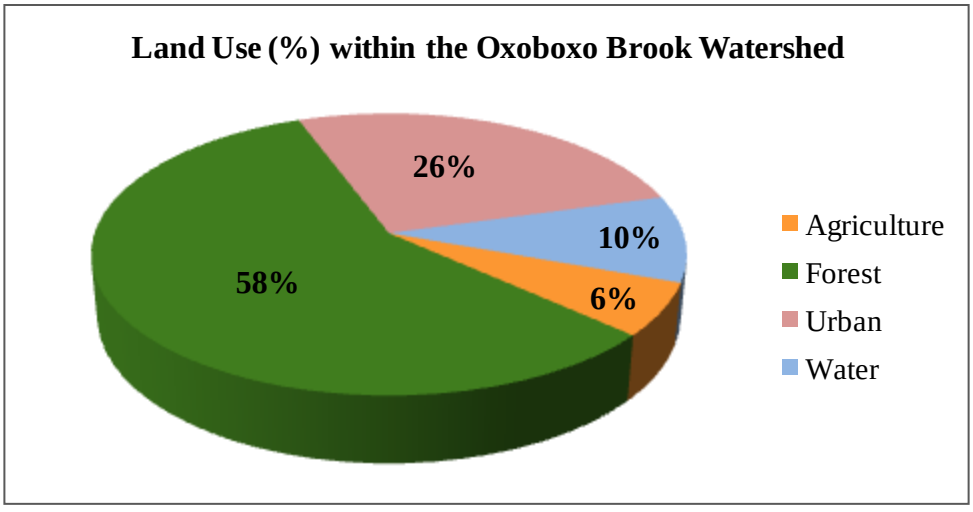
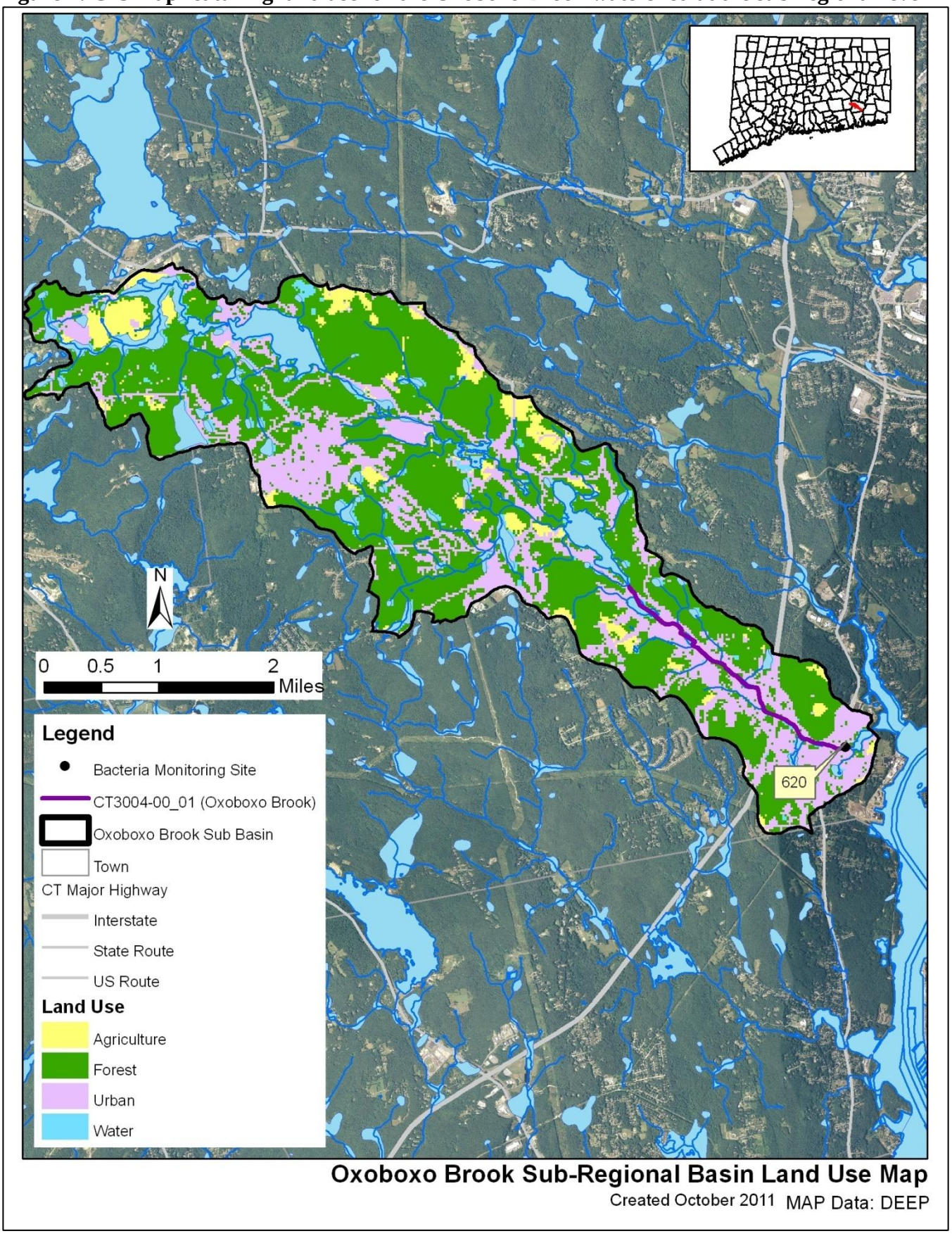


Figure 4: GIS map featuring land use for the Oxoboxo Brook watershed at the sub-regional level



WHY IS A TMDL NEEDED?

E. coli is the indicator bacteria used for comparison with the CT State criteria in the CT Water Quality Standards (WQS) (CTDEEP, 2011). All data results are from CT DEEP, USGS, Bureau of Aquaculture, or volunteer monitoring efforts at stations located on the impaired segments.

Table 2: Sampling station location description for the impaired Segment in the Oxoboxo Brook watershed

Waterbody ID	Waterbody Name	Station	Station Description	Municipality	Latitude	Longitude
CT3004-00_01	Oxoboxo Brook	620	At Faria Company (Pink Row Road)	Montville	41.436594	-72.106153

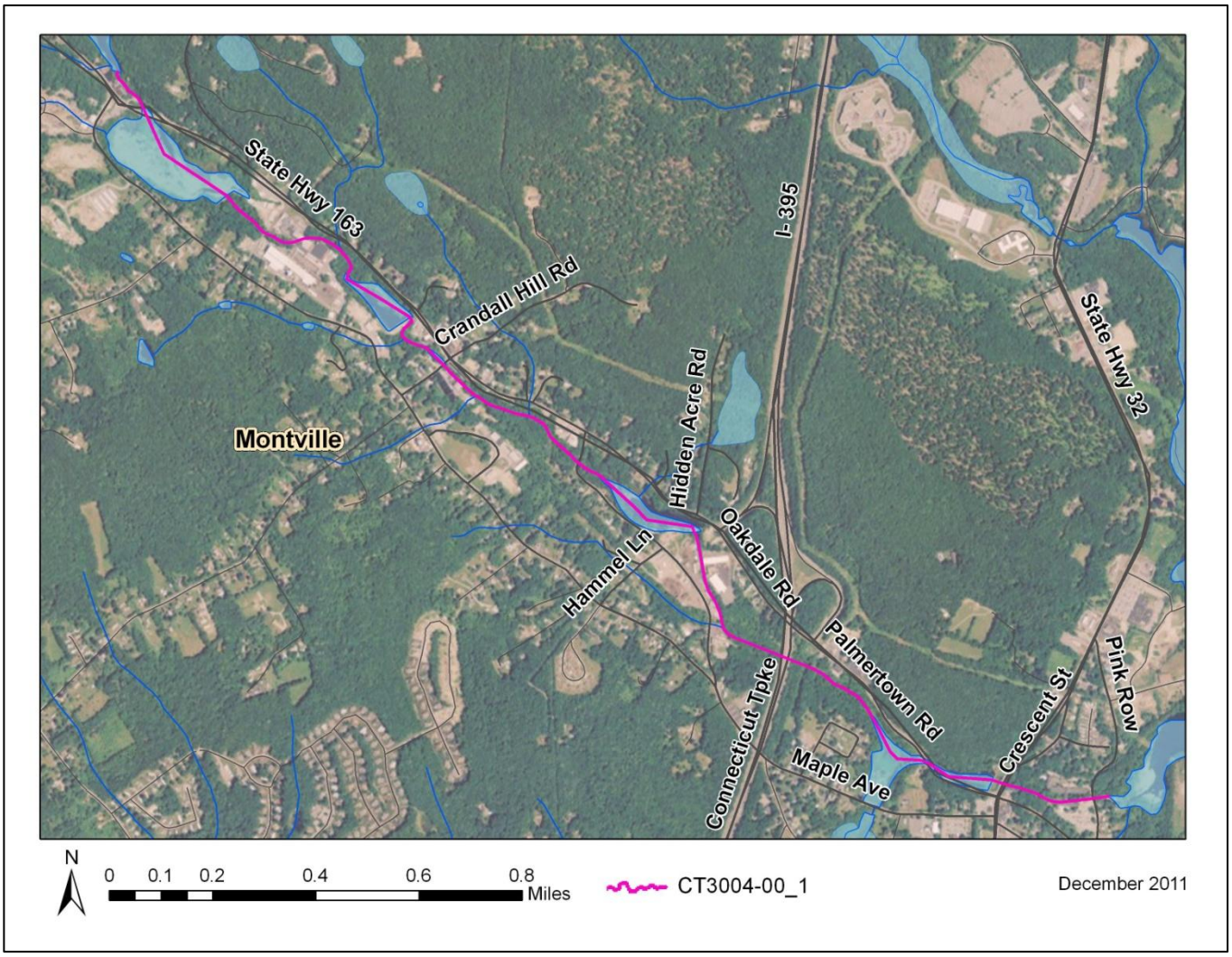
Oxoboxo Brook (CT3004-00_01) is a Class B freshwater river (Figure 5). Its applicable designated uses are habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. Water quality analyses were conducted using data from one sampling location from 2006-2009 (Station 620) (Table 2).

The water quality criteria for *E. coli*, along with bacteria sampling results for Station 620 from 2006-2009, are presented in Table 10. The annual geometric mean was calculated for Station 620 and exceeded the WQS for *E. coli* in 2008. Single sample values at this station also exceeded the WQS for *E. coli* twice in 2007 and once in 2008.

To aid in identifying possible bacteria sources, the geometric mean was calculated for Station 620 for wet-weather and dry-weather sampling days, where appropriate (Table 10). For Oxoboxo Brook, the *E. coli* geometric mean for samples taken in wet weather was well over three times the dry weather samples.

Due to the elevated bacteria measurements presented in Table 10, this segment of Oxoboxo Brook did not meet CT's bacteria WQS, was identified as impaired, and was placed on the CT List of Waterbodies Not Meeting Water Quality Standards, also known as the CT 303(d) Impaired Waters List. The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the impairments and identifies the measures needed to restore water quality. The goal is for all waterbodies to comply with State WQS.

Figure 5: Aerial map of Oxoboxo Brook



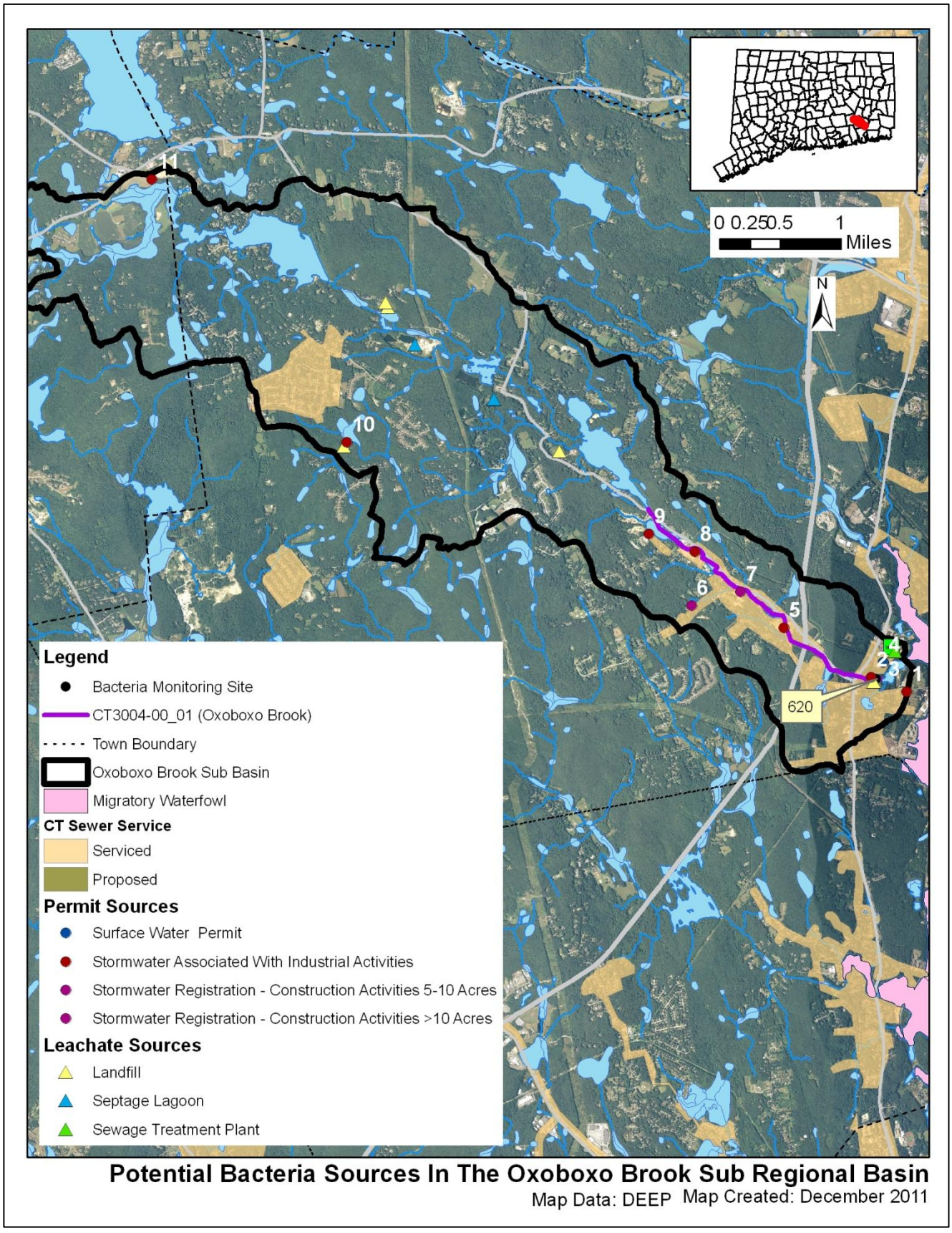
POTENTIAL BACTERIA SOURCES

Potential sources of indicator bacteria in a watershed include point and non-point sources, such as stormwater runoff, agriculture, sanitary sewer overflows (collection system failures), illicit discharges, and inappropriate discharges to the waterbody. Potential sources that have been tentatively identified in the watershed based on land use (Figures 3 and 4) and a collection of local information for the impaired waterbody is presented in Table 3 and Figure 6. However, the list of potential sources is general in nature and should not be considered comprehensive. There may be other sources not listed here that contribute to the observed water quality impairment in the study segments. Further monitoring and investigation will confirm listed sources and discover additional ones. Some segments in this watershed are currently listed as unassessed by CT DEEP procedures. This does not suggest that there are no potential issues on this segment, but indicates a lack of current data to evaluate the segment as part of the assessment process. For some segments, there are data from permitted sources, and CT DEEP recommends that any elevated concentrations found from those permitted sources be addressed through voluntary reduction measures. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement these TMDLs.

Table 3: Potential bacteria sources in the Oxoboxo Brook watershed

Impaired Segment	Permit Source	Illicit Discharge	CSO/ SSO Issue	Failing Septic System	Agricultural Activity	Stormwater Runoff	Nuisance Wildlife/Pets	Other
Oxoboxo Brook CT3004-00_01	**x**	**x**		**x**	**x**	**x**	**x**	**x**

Figure 6: Potential sources in the Oxoboxo Brook watershed at the sub-regional level



The potential sources map for the impaired basin was developed after thorough analysis of available data sets. If information is not displayed in the map, then no sources were discovered during the analysis. The following is the list of potential sources that were evaluated: problems with migratory waterfowl, golf course locations, reservoirs, proposed and existing sewer service, cattle farms, poultry farms, permitted sources of bacteria loading (surface water discharge, MS4 permit, industrial stormwater, commercial stormwater, groundwater permits, and construction related stormwater), and leachate and discharge sources (agricultural waste, CSOs, failing septic systems, landfills, large septic tank leach fields, septage lagoons, sewage treatment plants, and water treatment or filter backwash).

Point Sources

Permitted sources within the watershed that could potentially contribute to the bacteria loading are identified in Table 4. This table includes permit types that may or may not be present in the impaired watershed. A list of active permits in the watershed is included in Table 5. Additional investigation and monitoring may reveal the presence of additional discharges in the watershed. Available effluent data from each of these permitted categories found within the watershed are compared to the CT State WQS for the appropriate receiving waterbody use and type. When available, bacteria data results from these permitted sources are listed in Table 6.

Table 4: General categories list of other permitted discharges

Permit Code	Permit Description Type	Number in watershed
CT	Surface Water Discharges	1
GPL	Discharge of Swimming Pool Wastewater	0
GSC	Stormwater Discharge Associated with Commercial Activity	0
GSI	Stormwater Associated with Industrial Activity	8
GSM	Part B Municipal Stormwater MS4	1
GSN	Stormwater Registration – Construction	2
LF	Groundwater Permit (Landfill)	0
UI	Underground Injection	0

Permitted Sources

As shown in Table 5, there are multiple permitted discharges in the Oxoboxo Brook watershed. Bacteria data from 2001-2003 for three industrial permitted facilities are included in Table 6. Though this data cannot be compared to a water quality standard as there is no recreation standard for fecal coliform bacteria, samples from two outfalls at Thomas G. Faria Corporation (GSI1414) both exceeded 2,000 colonies/100mL in 2003. Samples from four outfalls at Rand-Whitney Container Board (GSI723) exceeded 1,700 colonies/100ml on at least one sampling date in 2001 and 2002, with the maximum being 33,000 colonies/100ml in 2002. Smurfit-Stone Container Corporation (GSI532) also had high counts above 1,400 colonies/100ml, but is located downstream of the impaired segment of Oxoboxo Brook.

Since the MS4 permits are not targeted to a specific location, but the geographic area of the regulated municipality, there is no one accurate location on the map to display the location of these permits. One

dot will be displayed at the geographic center of the municipality as a reference point. Sometimes this location falls outside of the targeted watershed and therefore the MS4 permit will not be displayed in the Potential Sources Map. Using the municipal border as a guideline will show which areas of an affected watershed are covered by an MS4 permit.

Several permitted sources and MS4 outfalls may be high contributors of bacterial contamination to the impaired segment of Oxoboxo Brook. Downstream of Picker Pond along Oxoboxo Brook, an MS4 outfall and permitted source at D&W Transport & Leasing exceeded single sample values on all sample dates. Downstream of Red Mill Pond in a commercial area along Route 163, sampling at Rand-Whitney Container Board revealed high fecal coliform counts with a maximum of 33,000 colonies/100mL. Thomas G. Faria Corporation along Route 32 downstream of the lower portion of Red Mill Pond had outfall sampling results above 2,000 colonies/100mL. Other permitted sources of particular concern include: Yale's Auto Salvage, Inc, a large car salvage yard with exposed soil at the outlet of Wheeler Pond; and Kobyluck Sand & Gravel, Inc, a large sand and gravel pit along Oxoboxo Dam Road upstream of the impaired segment.

Table 5: Permitted facilities within the Oxoboxo Brook watershed

Town	Client	Permit ID	Permit Type	Site Name/Address	Map #
Montville	Rand-Whitney Container Board L.P.	GSI000723	Stormwater Associated With Industrial Activities	Rand-Whitney Container Board L.P.	8
Montville	Yale Auto Salvage, Inc.	GSI001162	Stormwater Associated With Industrial Activities	Yale's Inc.	9
Montville	Kobyluck Sand And Gravel, Inc.	GSI002041	Stormwater Associated With Industrial Activities	Kobyluck Sand & Gravel, Inc.	10
Montville	Town of Montville	GSM000067	Part B Municipal Stormwater MS4	Montville, Town of	NA
Montville	1129 Route 32, Llc	GSN001818	Stormwater Registration - Construction Activities 5-10 Acres	Lot 7B	7
Montville	9R Burlake, Llc	GSN002105	Stormwater Registration - Construction Activities >10 Acres	Gay Hill Subdivision	6
Uncasville	Town Of Montville	CT0100935	Surface Water Permit	Montville WPCF	4
Uncasville	Smurfit-Stone Container Corporation	GSI000527	Stormwater Associated With Industrial Activities	Smurfit-Stone Container Corporation	1
Uncasville	Thomas G. Faria Corporation	GSI001414	Stormwater Associated With Industrial Activities	Thomas G. Faria Corporation	2
Uncasville	Town Of Montville	GSI001968	Stormwater Associated With Industrial Activities	Montville WPCF	3
Uncasville	D.W. Transport & Leasing	GSI001111	Stormwater Associated With Industrial Activities	D.W. Transport & Leasing, Inc.	5

Table 6: Industrial permits on Oxoboxo Brook and available fecal coliform data (colonies/100mL). The results cannot be compared to the water quality standard as there is no recreation standard for fecal coliform.

Town	Location	Permit Number	Receiving Water	Sample Location	Sample Date	Result
Montville	Thomas G. Faria	GSI1414	Oxoboxo Brook	outfall #1	02/27/02	>120
Montville	Thomas G. Faria	GSI1414	Oxoboxo Brook	outfall #1	07/24/03	>2000
Montville	Thomas G. Faria	GSI1414	Oxoboxo Brook	outfall #2	02/27/02	>120
Montville	Thomas G. Faria	GSI1414	Oxoboxo Brook	outfall #2	07/24/03	>2000
Montville	Stone Container Corp	GSI532	Oxoboxo Brook	swale	07/26/01	2,600
Montville	Stone Container Corp	GSI532	Oxoboxo Brook	swale	09/27/02	1,400
Montville	Rand-Whitney Containerboard	GSI723	Oxoboxo Brook	001	09/21/01	40
Montville	Rand-Whitney Containerboard	GSI723	Oxoboxo Brook	001	09/26/02	33,000
Montville	Rand-Whitney Containerboard	GSI723	Oxoboxo Brook	003	09/21/01	430
Montville	Rand-Whitney Containerboard	GSI723	Oxoboxo Brook	003	09/26/02	1,700
Montville	Rand-Whitney Containerboard	GSI723	Oxoboxo Brook	007	09/21/01	750
Montville	Rand-Whitney Containerboard	GSI723	Oxoboxo Brook	007	09/26/02	1,900
Montville	Rand-Whitney Containerboard	GSI723	Oxoboxo Brook	008	09/21/01	23
Montville	Rand-Whitney Containerboard	GSI723	Oxoboxo Brook	008	09/26/02	3,200

Municipal Stormwater Permitted Sources

Per the EPA Phase II Stormwater rule all municipal storm sewer systems (MS4s) operators located within US Census Bureau Urbanized Areas (UAs) must be covered under MS4 permits regulated by the appropriate State agency. There is an EPA waiver process that municipalities can apply for to not participate in the MS4 program. In Connecticut, EPA has granted such waivers to 19 municipalities. All participating municipalities within UAs in Connecticut are currently regulated under MS4 permits by CT DEEP staff in the MS4 program.

The US Census Bureau defines a UA as a densely settled area that has a census population of at least 50,000. A UA generally consists of a geographic core of block groups or blocks that exceeds the 50,000 people threshold and has a population density of at least 1,000 people per square mile. The UA will also include adjacent block groups and blocks with at least 500 people per square mile. A UA consists of all or part of one or more incorporated places and/or census designated places, and may include additional territory outside of any place. (67 FR 11663)

For the 2000 Census a new geographic entity was created to supplement the UA blocks of land. This created a block known as an Urban Cluster (UC) and is slightly different than the UA. The definition of a UC is a densely settled area that has a census population of 2,500 to 49,999. A UC generally consists of a geographic core of block groups or blocks that have a population density of at least 1,000 people per square mile, and adjacent block groups and blocks with at least 500 people per square mile. A UC consists of all or part of one or more incorporated places and/or census designated places; such a place(s) together with adjacent territory; or territory outside of any place. The major difference is the total population cap of 49,999 people for a UC compared to >50,000 people for a UA. (67 FR 11663)

While it is possible that CT DEEP will be expanding the reach of the MS4 program to include UC municipalities in the near future they are not currently under the permit. However, the GIS layers used to create the MS4 maps in this Statewide TMDL did include both UA and UC blocks. This factor creates some municipalities that appear to be within an MS4 program that are not currently regulated through an MS4 permit. This oversight can explain a municipality that is at least partially shaded grey in the maps and there are no active MS4 reporting materials or information included in the appropriate appendix. While these areas are not technically in the MS4 permit program, they are still considered urban by the cluster definition above and are likely to contribute similar stormwater discharges to affected waterbodies covered in this TMDL.

As previously noted, EPA can grant a waiver to a municipality to preclude their inclusion in the MS4 permit program. One reason a waiver could be granted is a municipality with a total population less than 1000 people, even if the municipality was located in a UA. There are 19 municipalities in Connecticut that have received waivers, this list is: Andover, Bozrah, Canterbury, Coventry, East Hampton, Franklin, Haddam, Killingworth, Litchfield, Lyme, New Hartford, Plainfield, Preston, Salem, Sherman, Sprague, Stafford, Washington, and Woodstock. There will be no MS4 reporting documents from these towns even if they are displayed in an MS4 area in the maps of this document.

The list of US Census UCs is defined by geographic regions and is named for those regions, not necessarily by following municipal borders. In Connecticut the list of UCs includes blocks in the following Census Bureau regions: Colchester, Danielson, Lake Pocotopaug, Plainfield, Stafford, Storrs, Torrington, Willimantic, Winsted, and the border area with Westerly, RI (67 FR 11663). Any MS4 maps showing these municipalities may show grey areas that are not currently regulated by the CT DEEP MS4 permit program.

The impaired segment of the Oxoboxo Brook watershed is located within the Town of Montville, CT. The town is largely urbanized, as defined by the U.S. Census Bureau, and is required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Storm Sewer Systems (MS4 permit) issued by the Connecticut Department of Energy and Environmental Protection (DEEP) (Figure 7). This general permit is only applicable to municipalities that are identified in Appendix A of the MS4 permit that contain designated urban areas and discharge stormwater via a separate storm sewer system to surface waters of the State. The permit requires municipalities to develop a Stormwater Management Plan (SMP) to reduce the discharge of pollutants and protect water quality. The MS4 permit is discussed further in the "TMDL Implementation Guidance" section of the core TMDL document. Additional information regarding stormwater management and the MS4 permit can be obtained on CTDEEP's website (http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325702&depNav_GID=1654).

Multiple MS4 outfalls have been sampled for *E. coli* bacteria in the watershed (Table 7). In Montville, three MS4 outfalls were sampled from 2006-2011. All outfalls exceeded the single sample water quality standard of 410 colonies/100 mL on at least one sampling date.

Figure 7: MS4 areas of the Oxoboxo Brook watershed

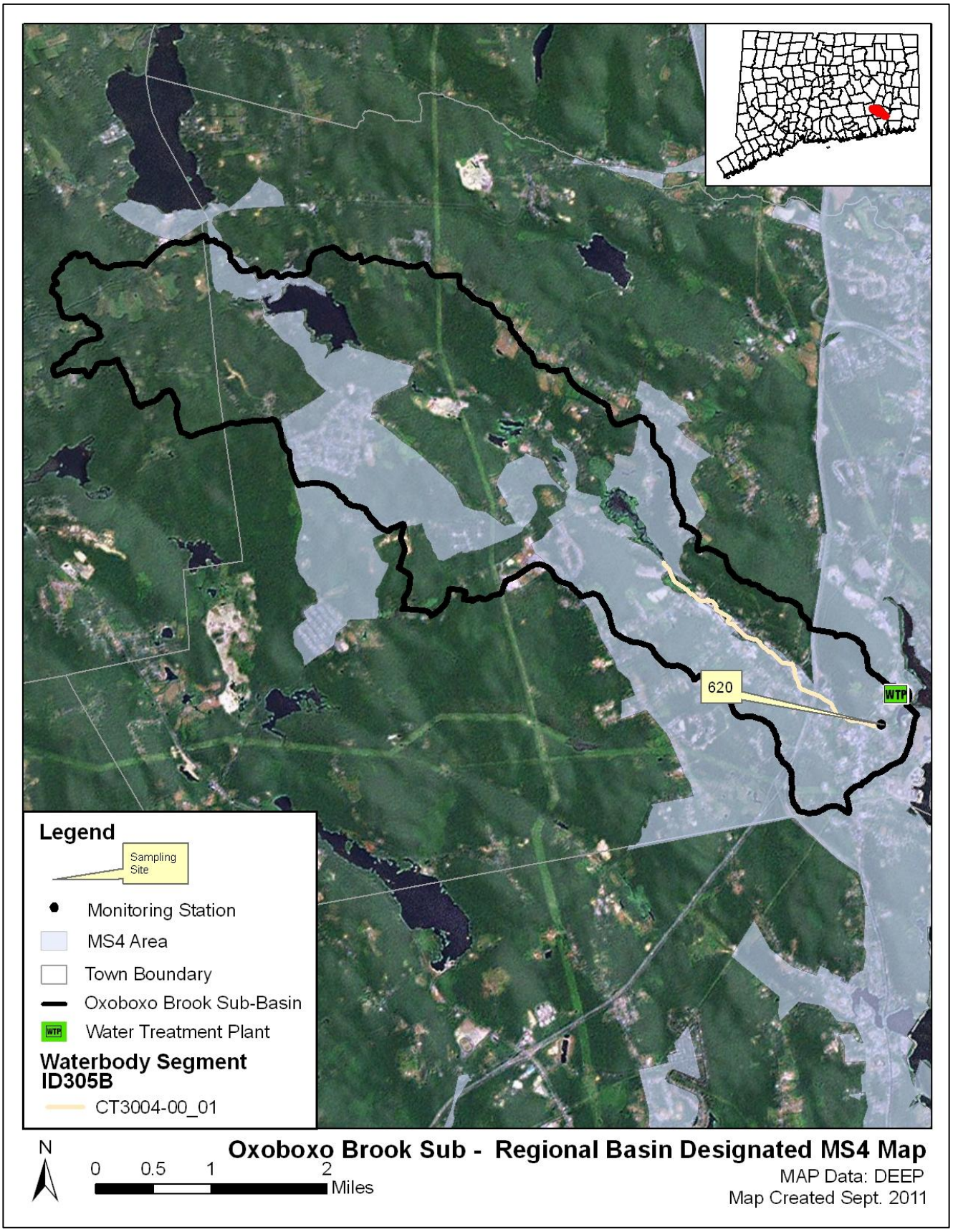


Table 7: List of MS4 sample locations and *E. coli* (colonies/100 mL) results in the Oxoboxo Brook watershed

Town	Location	MS4 Type	Receiving Waters	Sample Date	Result
Montville	I 400 Maple Ave - "D&W Transport"	Industrial	Oxoboxo Brook	12/01/06	20,000
Montville	I 400 Maple Ave - "D&W Transport"	Industrial	Oxoboxo Brook	12/13/06	1,000
Montville	I 400 Maple Ave - "D&W Transport"	Industrial	Oxoboxo Brook	09/11/07	2,000
Montville	I 400 Maple Ave - "D&W Transport"	Industrial	Oxoboxo Brook	01/11/08	4,000
Montville	I 400 Maple Ave - "D&W Transport"	Industrial	Oxoboxo Brook	04/26/08	6,000
Montville	I 400 Maple Ave - "D&W Transport"	Industrial	Oxoboxo Brook	06/06/09	17,330
Montville	I 400 Maple Ave - "D&W Transport"	Industrial	Oxoboxo Brook	10/19/11	>24,200
Montville	R20-2	Residential	Oxoboxo Brook	10/19/11	540
Montville	R40-2 Jeffery Manor Rd	Residential	Oxoboxo Brook	12/01/06	40
Montville	R40-2 Jeffery Manor Rd	Residential	Oxoboxo Brook	12/13/06	10
Montville	R40-2 Jeffery Manor Rd	Residential	Oxoboxo Brook	09/11/07	2,000
Montville	R40-2 Jeffery Manor Rd	Residential	Oxoboxo Brook	01/11/08	20
Montville	R40-2 Jeffery Manor Rd	Residential	Oxoboxo Brook	04/26/08	10
Montville	R40-2 Jeffery Manor Rd	Residential	Oxoboxo Brook	06/06/09	60
Montville	R40-2 Jeffery Manor Rd	Residential	Oxoboxo Brook	10/19/11	400
Shaded cells indicate an exceedance of single-sample based water quality criteria (410 colonies/100 mL)					

Publicly Owned Treatment Works

As shown in Figure 7, there is one publicly owned treatment works (POTW), or wastewater treatment plant, in the Oxoboxo Brook watershed near the outlet of Horton Cove, downstream of the impaired segment in Montville, CT. The Montville Water Pollution Control Facility (CT0100935) discharges directly to Gay Cemetery Pond downstream of the mouth of Oxoboxo Brook before it heads to Horton Cove along the Thames River. However, there are currently no data available for this facility.

Non-point Sources

Non-point source pollution (NPS) comes from many diffuse sources and is more difficult to identify and control. NPS pollution is often associated with land-use practices. Examples of NPS that can contribute bacteria to surface waters include insufficient septic systems, pet and wildlife waste, agriculture, and contact recreation (swimming or wading). Potential sources of NPS within the Oxoboxo Brook watershed are described below.

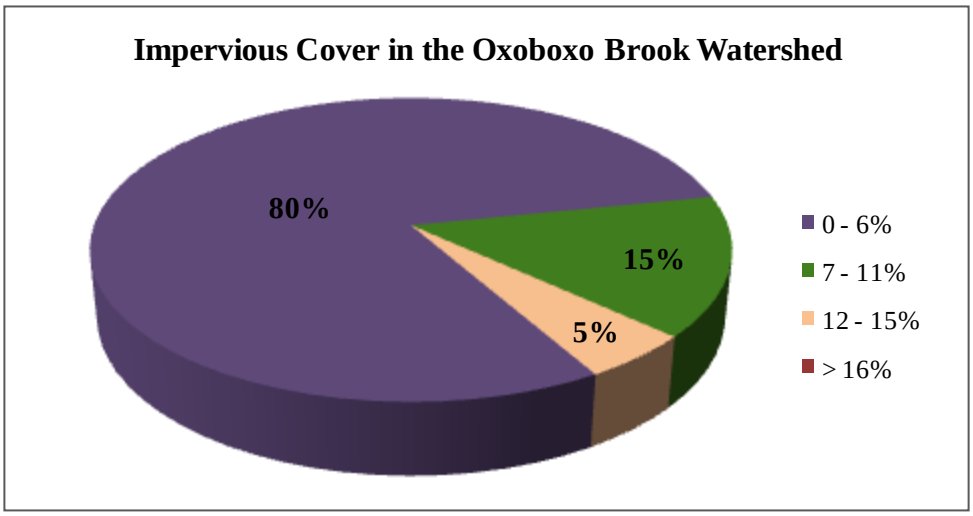
Stormwater Runoff from Developed Areas

Approximately 26% of the land use in the watershed is considered urban, particularly near the impaired segment, which flows through the commercial and industrial development along Oakdale Road (Route 163) (Figures 4 and 9). Car lots, landfills, hospitals, cemeteries, gun clubs, motels, and tennis-basketball courts depict this urban area. Urban areas are often characterized by impervious cover, or surface areas such as roofs and roads that force water to run off land surfaces rather than infiltrate into the soil. Studies have shown a link between increasing impervious cover and degrading water quality conditions in a

watershed (CWP, 2003). In one study, researchers correlated the amount of fecal coliform to the percent of impervious cover in a watershed (Mallin *et al.*, 2000).

As shown in Figure 8, approximately 15% of the Oxoboxo Brook watershed contains 7-11% impervious cover and 5% contains 12-15% impervious cover, particularly in the lower half of the area around the impaired segment (Figure 9). Water quality data taken at Station 620, located at the very downstream extent of the impaired segment, exceeded the geometric mean during wet-weather, which suggests that stormwater runoff may be a source of bacteria to the Oxoboxo Brook (Table 10).

Figure 8: Range of impervious cover (%) in the Oxoboxo Brook watershed

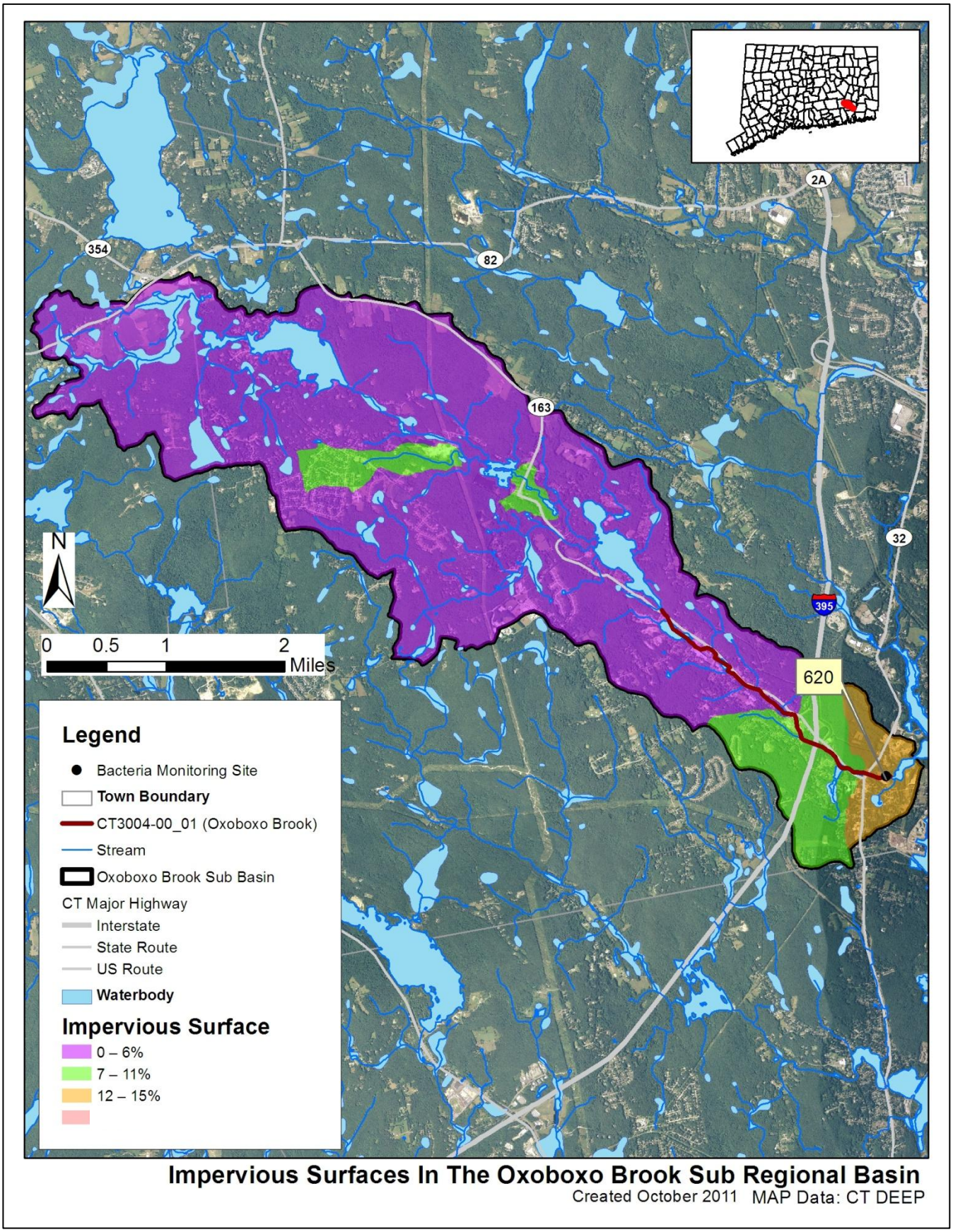


Insufficient Septic Systems and Illicit Discharges

As shown in Figure 6, the majority of the watershed upstream of Wheeler Pond relies on onsite wastewater treatment systems, such as septic systems. Insufficient or failing septic systems can be significant sources of bacteria by allowing raw waste to reach surface waters. A septage lagoon was identified at D&W Transport & Leasing just downstream of Paris Pond and adjacent to the impaired segment of Oxoboxo Brook. In Connecticut, local health directors or health districts are responsible for keeping track of any reported insufficient or failing septic systems in a specific municipality. The Town of Montville is a sovereign nation and is part of the Uncas Health District (http://www.uncashd.org/).

The area immediately surrounding the impaired segment of Oxoboxo Brook, downstream of Rockland Pond, is serviced by the municipal sewer system (Figure 6). Sewer system leaks and other illicit discharges or connections can contribute bacteria to nearby surface waters.

Figure 9: Impervious cover (%) for the Oxoboxo Brook sub-regional watershed



Wildlife and Domestic Animal Waste

Wildlife and domestic animals within the Oxoboxo Brook watershed represent another potential source of bacteria. With the construction of roads and drainage systems, these wastes may no longer be retained on the landscape, but instead may be conveyed via stormwater to the nearest surface water. These physical land alterations can exacerbate the impact of natural sources on water quality (USEPA, 2001). As the majority of the watershed upstream and along portions of the impaired segment is undeveloped, wildlife waste may be a potential source of bacteria to Oxoboxo Brook. Residential development and community parks in the watershed are located near the Oxoboxo Brook as well. As such, waste from domestic animals, such as dogs, may also be contributing to bacteria concentrations in the impaired segment of the Oxoboxo Brook watershed.

The Quaker Hill Rod & Gun Club is located within the Oxoboxo Brook watershed upstream of the impaired segment (Figure 6). A mansion along Wheeler Pond with a large open lawn extending right to the shoreline may serve as a geese attractant as well. Geese and other waterfowl are known to congregate in open areas including recreational fields, agricultural crop fields, and golf courses. In addition to creating a nuisance, large numbers of geese can also create unsanitary conditions on the grassed areas and cause water quality problems due to bacterial contamination associated with their droppings. Large populations of geese can also lead to habitat destruction as a result of overgrazing on wetland and riparian plants.

Agricultural Activities

Agricultural operations are an important economic activity and landscape feature in many areas of the State. Runoff from agricultural fields may contain pollutants such as bacteria and nutrients (USEPA, 2011a). This runoff can include pollutants from farm practices such as storing manure, allowing livestock to wade in nearby waterbodies, applying fertilizer, and reducing the width of vegetated buffer along the shoreline. Agricultural land use makes up 6% of the Oxoboxo Brook watershed. Although there are no major agricultural areas near the impaired segment, there are multiple hayfields, row crops, and livestock farms located in the upper half of the Oxoboxo Brook watershed upstream of the impaired segment along Route 163. Agricultural activities are most likely a small source of bacteria to Oxoboxo Brook; however, an identified livestock or horse farm near the north shore of Wheeler Pond should be monitored for potential contamination.

Additional Sources

As identified in Figure 6, four landfills are located upstream of the impaired segment, three of which are along the main stem flowing directly to Wheeler Pond. One landfill is also located at the mouth of the impaired segment near Station 620.

There may be other sources not listed here or identified in Figure 6 that contribute to the observed water quality impairment in Oxoboxo Brook. Further monitoring and investigation will confirm the listed sources and discover additional ones. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement this TMDL.

Land Use/Landscape

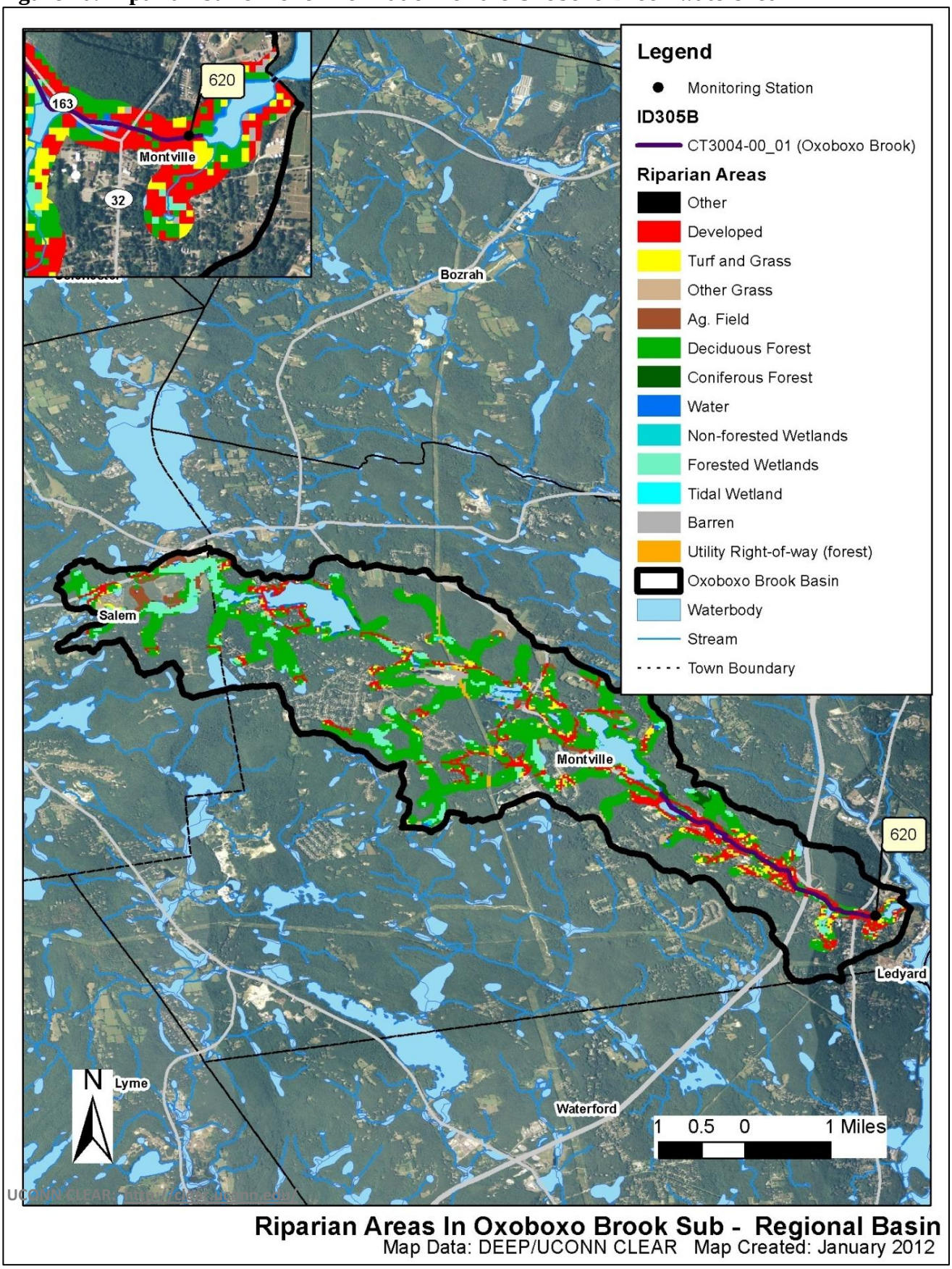
Riparian Buffer Zones

The riparian buffer zone is the area of land located immediately adjacent to streams, lakes, or other surface waters. The boundary of the riparian zone and the adjoining uplands is gradual and not always well-defined. However, riparian zones differ from uplands because of high levels of soil moisture, frequent flooding, and the unique assemblage of plant and animal communities found there. Through the interaction of their unique soils, hydrology, and vegetation, natural riparian areas influence water quality as contaminants are taken up into plant tissues, adsorbed onto soil particles, or modified by soil organisms. Any change to the natural riparian buffer zone can reduce the effectiveness of the natural buffer and has the potential to contribute to water quality impairment (USEPA, 2011b).

The CLEAR program at UCONN has created streamside buffer layers for the entire State of Connecticut (http://clear.uconn.edu/), which have been used in this TMDL. Analyzing this information can reveal potential sources and implementation opportunities at a localized level. The land use directly adjacent to a waterbody can have direct impacts on water quality from surface runoff sources.

The majority of the riparian zone for the impaired segment of Oxoboxo Brook is characterized by developed land use (Figure 10). Riparian areas upstream of this impaired segment are characterized by forested land use with small portions of developed and barren areas. As previously noted, if not properly treated, runoff from developed areas may contain pollutants such as bacteria and nutrients.

Figure 10: Riparian buffer zone information for the Oxoboxo Brook watershed



CURRENT MANAGEMENT ACTIVITIES

CT DEEP's Non-Point Source Pollution Program administers a Non-Point Source Grant Program with funding from EPA under Section 319 of the Clean Water Act (319 grant). A $75,000 grant under this program was awarded to the University of Connecticut's Departments of Plant Science and Cooperative Extension to create multiple on-site demonstration projects or season-long consultations on proper agricultural BMPs with the goal to quantify reductions in pesticide and nutrient loading to the Oxoboxo Brook and surrounding watersheds (http://www.depdata.ct.gov/maps/nps/npsmap.htm).

As indicated previously, Montville is regulated under the MS4 program. The MS4 General Permit is required for any municipality with urbanized areas that initiates, creates, originates or maintains any discharge of stormwater from a storm sewer system to waters of the State. The MS4 permit requires towns to design a Stormwater Management Plan (SMP) to reduce the discharge of pollutants in stormwater to improve water quality. The plan must address the following 6 minimum measures:

1. Public Education and Outreach.
2. Public Involvement/Participation.
3. Illicit discharge detection and elimination.
4. Construction site stormwater runoff control.
5. Post-construction stormwater management in new development and redevelopment.
6. Pollution prevention/good housekeeping for municipal operations.

Each town is also required to submit an annual update outlining the steps they are taking to meet the six minimum measures. All updates that address bacterial contamination in the watershed are summarized in Table 8.

Table 8: Summary of MS4 requirement updates related to the reduction of bacterial contamination from Montville, CT (Permit # GSM000067)

Minimum Measure	Montville MS4 General Permit (2010)
Public Outreach and Education	1) Will include a stormwater tab to the Town of Montville website.
Public Involvement and Participation	1) Provided extensive recycling options for residents, including hazardous waste, yard waste, furniture, electronics, etc.
Illicit Discharge Detection and Elimination	1) Completed outfall mapping and integrated into town GIS. 2) Will develop an illicit discharge ordinance.
Construction Site Stormwater Runoff Control	1) Conducted periodic inspections during town road construction and subdivision construction.
Post Construction Stormwater Management	1) Encouraged Design Engineers and Developers to implement stormwater treatment practices.
Pollution Prevention and Good Housekeeping	1) Conducted annual street sweeping and catch basin cleaning program. 50% of drainage structures are cleaned once every two years. 2) Trained municipal employees and contractors on preventing pollutant runoff from municipal operations.

RECOMMENDED NEXT STEPS

The Town of Montville has developed and implemented programs to protect water quality from bacterial contamination. Future mitigative activities are necessary to ensure the long-term protection of the Oxoboxo Brook and have been prioritized below.

1) Continue monitoring of permitted sources.

Previous discharge sampling from Rand-Whitney Container Board and Thomas G. Faria Corporation along the impaired segment of Oxoboxo Brook has shown elevated levels of fecal coliform bacteria, an indicator of bacterial pollution (Table 6). Several industrial and construction permits have been identified adjacent to the impaired segment, including D&W Transport & Leasing, Yale's Auto Salvage, Inc, and Kobyluck Sand & Gravel, Inc, and may pose a threat to the water quality in Oxoboxo Brook (Figure 6). Further monitoring will provide information essential to better locate, understand, and reduce pollution sources. If any current monitoring is not done with appropriate bacterial indicator based on the receiving water, then a recommended change during the next permit reissuance is to include the appropriate indicator species. If facility monitoring indicates elevated bacteria, then implementation of permit required, and voluntary measures to identify and reduce sources of bacterial contamination at the facility are an additional recommendation. Regular monitoring should be established for all permitted sources to ensure compliance with permit requirements and to determine if current requirements are adequate or if additional measures are necessary for water quality protection.

Section 6(k) of the MS4 General Permit requires a municipality to modify their Stormwater Management Plan to implement the TMDL within four months of TMDL approval by EPA if stormwater within the municipality contributes pollutant(s) in excess of the allocation established by the TMDL. For discharges to impaired waterbodies, the municipality must assess and modify the six minimum measures of its plan, if necessary, to meet TMDL standards. Particular focus should be placed on the following plan components: public education, illicit discharge detection and elimination, stormwater structures cleaning, and the repair, upgrade, or retrofit of storm sewer structures. The goal of these modifications is to establish a program that improves water quality consistent with TMDL requirements. Modifications to the Stormwater Management Plan in response to TMDL development should be submitted to the Stormwater Program of DEEP for review and approval.

Table 9 details the appropriate bacteria criteria for use as waste load allocations established by this TMDL for use as water quality targets by permittees as permits are renewed and updated, within the Oxoboxo Brook watershed.

For any municipality subject to an MS4 permit and affected by a TMDL, the permit requires a modification of the SMP to include BMPs that address the included impairment. In the case of bacteria related impairments municipal BMPs could include: implementation or improvement to existing nuisance wildlife programs, septic system monitoring programs, any additional measures that can be added to the required illicit discharge detection and elimination (IDDE) programs, and increased street sweeping above basic permit requirements. Any non-MS4 municipalities can implement these same types of initiatives in effort to reduce bacteria source loading to impaired waterways.

Any facilities that discharge non-MS4 regulated stormwater should update their Pollution Prevention Plan to reflect BMPs that can reduce bacteria loading to the receiving waterway. These BMPs could include nuisance wildlife control programs and any installations that increase surface infiltration to reduce overall

stormwater volumes. Facilities that are regulated under the Commercial Activities Stormwater Permit should report any updates to their SMP in their summary documentation submitted to DEEP.

Table 9. Bacteria (e.coli) TMDLs, WLAs, and LAs for Recreational Use

		Instantaneous *E. coli* (#/100mL)						Geometric Mean *E. coli* (#/100mL)	
Class	**Bacteria Source**	**WLA[6]**			**LA[6]**			**WLA[6]**	**LA[6]**
B[4]	Non-Stormwater NPDES	235	410	576				126	
	CSOs	235	410	576				126	
	SSOs	0	0	0				0	
	Illicit sewer connection	0	0	0				0	
	Leaking sewer lines	0	0	0				0	
	Stormwater (MS4s)	235[7]	410[7]	576[7]				126[7]	
	Stormwater (non-MS4)				235[7]	410[7]	576[7]		126[7]
	Wildlife direct discharge				235[7]	410[7]	576[7]		126[7]
	Human or domestic animal direct discharge[5]				235	410	576		126

(1) **Designated Swimming.** Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in: Guidelines for Monitoring Bathing Waters and Closure Protocol, adopted jointly by the Department of Environmental Protections and the Department of Public Health. May 1989. Revised April 2003 and updated December 2008.

(2) **Non-Designated Swimming.** Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely.

(3) **All Other Recreational Uses.**

(4) Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of sewage treatment plant effluents is not required consistent with Standard 23. (Class B surface waters located north of Interstate Highway I-95 and downstream of a sewage treatment plant providing seasonal disinfection May 1 through October 1, as authorized by the Commissioner.)

(5) Human direct discharge = swimmers

(6) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations

(7) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP 2011a). Sections 2.2.2 and 6.2.7 of this Core Document deal with BMPs and delineating type of wildlife inputs.

2) Identify areas along Oxoboxo Brook to implement Best Management Practices (BMPs) to control stormwater runoff.

As noted previously, 26% of the Oxoboxo Brook watershed is considered urban, and the Town of Montville is a MS4 community regulated by the MS4 program. The impaired segment flows through industrial and commercial development along Route 163, and Station 620 at the mouth of Oxoboxo Brook exceeded wet-weather geometric mean limits. As such, stormwater runoff is most likely contributing bacteria to the waterbodies. To identify other areas that are contributing bacteria to the impaired segment, Montville should continue to conduct wet-weather sampling at stormwater outfalls that discharge directly to the impaired segment of the Oxoboxo Brook watershed. Outfalls that have previously shown high bacteria concentrations should be prioritized for BMP installation (Table 6). To treat stormwater runoff, the towns should identify areas along the impaired segment to install BMPs designed to encourage stormwater to infiltrate into the ground before entering the waterbodies. These BMPs would disconnect impervious areas and reduce pollutant loads to the river. More detailed information and BMP recommendations can be found in the core TMDL document.

3) Implement a program to evaluate the sanitary sewer system.

The lower portion of the Oxoboxo Brook watershed, particularly along Route 163 parallel to the impaired segment, relies on a municipal sewer system (Figure 6). Montville has already begun mapping of stormwater outfalls. It is important for Montville to continue to develop a program that evaluates its sanitary sewer and reduce leaks and overflows. This program should include periodic inspections of the sewer line.

4) Evaluate municipal education and outreach programs regarding animal waste.

As most of the Oxoboxo Brook watershed upstream of the impaired segment is undeveloped and the impaired segment itself flows through portions of residential development, any education and outreach program should highlight the importance of picking up after horses, dogs, and other pets and not feeding waterfowl and wildlife. The town and residents can take measures to minimize waterfowl-related impacts such as allowing tall, coarse vegetation to grow in the riparian areas of the Oxoboxo Brook that are frequented by waterfowl. Waterfowl, especially grazers like geese, prefer easy access to water. Maintaining an uncut vegetated buffer along the shore will make the habitat less desirable to geese and encourage migration. In addition, any educational program should emphasize that feeding waterfowl, such as ducks, geese, and swans, may contribute to water quality impairments in Oxoboxo Brook and can harm human health and the environment. Animal wastes should be disposed of away from any waterbody or storm drain system. BMPs effective at reducing the impact of animal waste on water quality include installing signage, providing pet waste receptacles in high-use areas, enacting ordinances requiring the clean-up of pet waste, and targeting educational and outreach programs in problem areas.

5) Develop a system to monitor septic systems.

Though the majority of the area surrounding the impaired segment relies on the municipal sanitary sewer system, most residents upstream of the impaired segment rely on septic systems. If not already in place, Montville should establish a program to ensure that existing septic systems are properly operated and maintained, and create an inventory of existing septic systems through mandatory inspections. Inspections help encourage proper maintenance and identify failed and sub-standard systems. Policies that govern the eventual replacement of sub-standard systems within a reasonable timeframe can be adopted. Montville can also develop a program to assist citizens with the replacement and repair of older and failing systems.

6) Ensure there are sufficient buffers on agricultural lands along the Oxoboxo Brook.

Agricultural land use represents 6% of the Oxoboxo Brook watershed, and may be a concern for water quality, especially with an identified livestock or horse farm within the riparian buffer zone of Wheeler Pond (Figure 10). If not already in place, agricultural producers should work with the CT Department of Agriculture and the U.S. Department of Agriculture Natural Resources Conservation Service to develop conservation plans for their farming activities within the watershed. These plans should focus on ensuring that there are sufficient stream buffers, that fencing exists to restrict livestock and horse access to streams and wetlands, and that animal waste handling, disposal, and other appropriate Best Management Practices (BMPs) are in place.

BACTERIA DATA AND PERCENT REDUCTIONS TO MEET THE TMDL

Table 10: Oxoboxo Brook Bacteria Data

Waterbody ID: CT3004-00_01

Characteristics: Freshwater, Class B, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, and Industrial and Agricultural Water Supply

Impairment: Recreation (*E. coli bacteria)*

Water Quality Criteria for E. coli:

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

Percent Reduction to meet TMDL:

Geometric Mean: **43%**

Single Sample: **94%**

Data: 2006-2009 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

Single sample *E. coli* (colonies/100 mL) data from Station 620 on Oxoboxo Brook with annual geometric means calculated

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
620	At Faria Company (Pink Row Road)	6/21/2006	108†	dry	73
620	At Faria Company (Pink Row Road)	6/28/2006	325†	dry	
620	At Faria Company (Pink Row Road)	7/3/2006	73	dry	
620	At Faria Company (Pink Row Road)	7/11/2006	98	dry	
620	At Faria Company (Pink Row Road)	7/18/2006	98	dry	
620	At Faria Company (Pink Row Road)	7/27/2006	26†	dry	
620	At Faria Company (Pink Row Road)	8/2/2006	75	dry	
620	At Faria Company (Pink Row Road)	8/9/2006	31	dry	
620	At Faria Company (Pink Row Road)	8/16/2006	140	wet	
620	At Faria Company (Pink Row Road)	8/23/2006	20	dry	
620	At Faria Company (Pink Row Road)	9/11/2006	74	dry	

Single sample *E. coli* (colonies/100 mL) data from Station 620 on Oxoboxo Brook with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
620	At Faria Company (Pink Row Road)	6/6/2007	250	wet	113
620	At Faria Company (Pink Row Road)	6/13/2007	31	dry	
620	At Faria Company (Pink Row Road)	6/20/2007	170	dry	
620	At Faria Company (Pink Row Road)	7/11/2007	52†	dry	
620	At Faria Company (Pink Row Road)	7/19/2007	1100	wet	
620	At Faria Company (Pink Row Road)	7/26/2007	52	dry	
620	At Faria Company (Pink Row Road)	8/9/2007	180	wet	
620	At Faria Company (Pink Row Road)	8/23/2007	41	wet	
620	At Faria Company (Pink Row Road)	9/4/2007	10	dry	
620	At Faria Company (Pink Row Road)	9/12/2007	1200	wet	
620	At Faria Company (Pink Row Road)	6/4/2008	320	wet**	**221* (43%)**
620	At Faria Company (Pink Row Road)	6/11/2008	110	dry**	
620	At Faria Company (Pink Row Road)	6/19/2008	305†	dry**	
620	At Faria Company (Pink Row Road)	6/25/2008	150	wet**	
620	At Faria Company (Pink Row Road)	7/2/2008	150	dry**	
620	At Faria Company (Pink Row Road)	7/9/2008	260	dry**	
620	At Faria Company (Pink Row Road)	7/16/2008	180	dry**	
620	At Faria Company (Pink Row Road)	7/23/2008	120	wet**	
620	At Faria Company (Pink Row Road)	7/30/2008	130†	dry**	
620	At Faria Company (Pink Row Road)	8/6/2008	**7300* (94%)**	wet**	
620	At Faria Company (Pink Row Road)	8/13/2008	250	dry**	
620	At Faria Company (Pink Row Road)	8/21/2008	41	dry**	

Single sample *E. coli* (colonies/100 mL) data from Station 620 on Oxoboxo Brook with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
620	At Faria Company (Pink Row Road)	6/3/2009	41	dry**	51
620	At Faria Company (Pink Row Road)	6/11/2009	86	wet**	
620	At Faria Company (Pink Row Road)	6/25/2009	41	dry**	
620	At Faria Company (Pink Row Road)	7/9/2009	240	wet	
620	At Faria Company (Pink Row Road)	7/16/2009	10	dry	
620	At Faria Company (Pink Row Road)	7/23/2009	52†	wet	
620	At Faria Company (Pink Row Road)	7/29/2009	52	dry	
620	At Faria Company (Pink Row Road)	8/6/2009	73†	dry	
620	At Faria Company (Pink Row Road)	8/13/2009	86	dry	
620	At Faria Company (Pink Row Road)	8/20/2009	20	dry	

Shaded cells indicate an exceedance of water quality criteria

†Average of two duplicate samples

**** Weather conditions for selected data taken from Hartford because local station had missing data**

***Indicates single sample and geometric mean values used to calculate the percent reduction**

Wet and dry weather geometric mean values for Station 620 on Oxoboxo Brook

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
620	At Faria Company (Pink Row Road)	2006-2009	13	30	101	251	68

Shaded cells indicate an exceedance of water quality criteria

Weather condition determined from rain gages at Norwich Public Utility Plant in Norwich, CT and Hartford Bradley International Airport

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